**Bohr-Rutherford Diagrams for Neutral Atoms (2016)**

The Bohr-Rutherford model of the atom states that the protons and neutrons are in the nucleus. The electrons orbit the nucleus in energy levels called shells or orbitals. There are a maximum number of electrons per orbital.

**Orbitals or Shells**

Electrons **cannot** be found between orbitals, but can move up or down from one orbital to another. Electrons closer to the nucleus have less energy, electrons farther from the nucleus have more energy.

|  |  |
| --- | --- |
| **Period Number** | **Number of Orbitals?** |
| **1** | **1** |
| **2** | **2** |
| **3** | **3** |
| **4** | **4** |

Orbital Trends in the periodic table

**Drawing Bohr-Rutherford Diagrams**

Bohr-Rutherford diagrams represent the arrangement of protons, neutrons, and electrons in an atom of an element. In these diagrams, the number of protons and neutrons is written in a central circle to represent the nucleus of the atom.

**Drawing Orbitals**

Circles are drawn around the nucleus to represent orbitals, and electrons are shown in these orbitals. The number of orbitals for an element is the period number. The maximum number of electrons in an orbital is the number of the elements in the period.

**Draw the Bohr-Rutherford Diagram for Lithium**

Atomic Number = \_\_\_

Atomic Mass = \_\_\_\_

# protons = \_\_\_\_

# electrons = \_\_\_\_

# neutrons = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Rules for Adding Electrons to Orbitals**

* The first orbital can hold up to 2 electrons.
* The second and third orbitals can hold up to 8 electrons.
* When filling orbitals with electrons, place the first 4 electrons at a compass point before pairing.

**Draw the Bohr-Rutherford Diagram for Aluminum**

Atomic Number = \_\_\_

Atomic Mass = \_\_\_\_

# protons = \_\_\_\_

# electrons = \_\_\_\_

# neutrons = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Valence Electrons**

The electrons in the outer orbital are called **valence electrons.** How many valence electrons does lithium have? Just 1! The number of valence electrons depends on the group number in the periodic table.

Valence Electron Trends

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group # | **1** | **2** | **13** | **14** | **15** | **16** | **17** | **18** |
| # of bonds? | 1 | 2 | 3 | 4 | 3 | 2 | 1 | 0 |
| # Valence Electrons? | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

**Summary – Rules for Drawing Bohr-Rutherford Diagrams**

* First circle = nucleus, write # protons and # neutrons
* Determine the period and draw one orbital for each period
* Determine the number of electrons and draw in the correct positions
  + Starting in the first orbital draw in a max of 2 electrons always at the top
  + Move to the second orbital for a max of 8 electrons, one in each compass point, then in partners
  + Move to the third orbital for a max of 8 more electrons

**Bohr-Rutherford Diagrams for Neutral Atoms (2016)**

The Bohr-Rutherford model of the atom states that the protons and neutrons are in the nucleus. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in spaces called shells or orbitals. There are a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ per orbital.

**Orbitals or Shells**

Electrons **\_\_\_\_\_\_\_\_\_\_\_\_\_** be found between orbitals, but can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one orbital to another. Electrons closer to the nucleus have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, electrons farther from the nucleus have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| **Period Number** | **Number of Orbitals?** |
| **1** |  |
| **2** |  |
| **3** |  |
| **4** |  |

**Orbital Trends in the periodic table**

**Drawing Bohr-Rutherford Diagrams**

Bohr-Rutherford diagrams represent the arrangement of protons, neutrons, and electrons in an atom of an element. In these diagrams, the number of protons and neutrons is written in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to represent the nucleus of the atom.

**Drawing Orbitals**

Circles are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and electrons are shown in these orbitals. The number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for an element is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ number of electrons in an orbital is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the period.

**Draw the Bohr-Rutherford Diagram for Lithium**

Atomic Number = \_\_\_

Atomic Mass = \_\_\_\_

# protons = \_\_\_\_

# electrons = \_\_\_\_

# neutrons = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Rules for Adding Electrons to Orbitals**

* The first orbital can hold up to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ orbitals can hold up to **8** electrons.
* When filling orbitals with electrons, place the first 4 electrons at a \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ before pairing.

**Draw the Bohr-Rutherford Diagram for Aluminum**

Atomic Number = \_\_\_

Atomic Mass = \_\_\_\_

# protons = \_\_\_\_

# electrons = \_\_\_\_

# neutrons = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Valence Electrons**

The electrons \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_are called **valence electrons.** How many valence electrons does lithium have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ The number of valence electrons depends on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the periodic table.

**Valence Electron Trends**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group # | **1** | **2** | **13** | **14** | **15** | **16** | **17** | **18** |
| # of bonds? |  |  |  |  |  |  |  |  |
| # Valence Electrons? |  |  |  |  |  |  |  |  |

**Summary – Rules for Drawing Bohr-Rutherford Diagrams**

* **First circle = nucleus, write # protons and # neutrons**
* Determine the period and **draw one orbital for each period**
* Determine the number of electrons and draw in the correct positions
  + Starting in the **first orbital draw in a max of 2 electrons always at the top**
  + Move to the **second** orbital for a **max of 8** electrons, one in each compass point, then in partners
  + Move to the third orbital for a max of 8 more electrons